e) heat treating at least a portion of the optical component to develop nanocrystals within the precursor glass, thereby forming a glass ceramic;

wherein the optoelectronic material is in the form of a clad optical fiber,

and

wherein the glass-ceramic forms a core of the optical fiber, the core has a CTE in the range of 10-90x10^{-7}/°C, and the cladding has a CTE in the range of 5-70x10^{-7}/°C.

8. (Amended) The method in accordance with claim 1, wherein the optical fiber cladding is a silica glass modified by at least one oxide selected from the group composed of B, Ge, P, Ga, Al, Ta, Ti, or Sb oxides.

11. (Amended) The method in accordance with claim 1, wherein the glass-ceramic core has a CTE in the range of 20-70x10^{-7}/°C, and the cladding has a CTE in the range of 15-60x10^{-7}/°C.

REMARKS

In the Office Action the Examiner indicated that claims 12 and 13 are allowable, and that claims 10-11, 14, and 16-17, while being objected to as being dependent on a rejected base claim, would be allowable if rewritten in independent form including all the limitation of the base claim and any intervening claims. With regard to these latter claims the following is noted.

- Claim 10 depends on clam 7 and claim 7 depends on claim 1.
- Claim 11 depends on claim 10.
- Claim 14 depends on claims 1 or 13.
- Claim 16 depends on claim 1 or 13.
- Claim 17 depends on claim 16.

Applicants accept the allowance of claims 12 and 13.

Applicants have amended claim 1 to incorporate the subject matter of claims 7 and 10 by the addition of "wherein" clauses. In addition, applicants have amended the dependency of claims 8 and 11 so that they now depend on claim 1 instead of claims 7 and 10, to reflect

the cancellation of claim 7 and 10 and their incorporation into claim 1. A Marked-up copy of the claims showing the amendments made is enclosed with this paper.

Applicants believe that in view of the Examiner's statement in the Office Action, the amended claim 1 is now in allowable form. Further, applicants submit that claims 2-6, 8, 9, 11 and 14-17, which also depend on and further limit, claim 1 are allowable by reason of depending on an allowable claim. (As noted above, claims 14-16 depend on both claim 1 and 13. The Examiner has indicated that claim 13 is allowable. Accordingly, claims 14-16 and claim 17 which depends on claim 16, are submitted as being allowable in their dependency on claim 13.) With regard to the art cited in the Office Action, applicants submit that the amendments made herein take the amended claims outside what is disclosed in that art.

Conclusion

Based upon the above Amendments, Remarks, and papers of record, applicants believe the pending claims of the above-captioned application are in allowable form and patentable over the prior art of record. Applicants respectfully request reconsideration of the pending claims and a prompt Notice of Allowance thereon.

Please direct any questions or comments to Walter M. Douglas at (607) 974-2431. If there is any matter whose speedy resolution would facilitate prosecution and allowance of the claimed invention, applicants' attorney requests that the Examiner call him.

Respectfully submitted,

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Date: 13 March 2003

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to Assistant Commissioner of Patents and Trademarks, Washington, DC 20231 on 13 March 2003
Date of Deposit

Walter M. Douglas Signature

Application No. 09/691,427
Marked-up Copy of Claims Showing Changes Made.

WE CLAIM:

1. (Amended) A method of making a glass ceramic optoelectronic material comprising:

a) preparing a glass composition to yield a precursor glass for a nanocrystalline glass ceramic doped with at least one kind of optically active ion, the precursor glass having a crystallization temperature;

b) forming the precursor glass into a glass cane;

c) surrounding the glass cane with a chemically inert cladding material;

d) forming from the glass cane an optical component at a temperature above the crystallization temperature of the precursor glass;

A1

e) heat treating at least a portion of the optical component to develop nanocrystals within the precursor glass, thereby forming a glass ceramic;

wherein the optoelectronic material is in the form of a clad optical fiber, and

wherein the glass-ceramic forms a core of the optical fiber, the core has a CTE in the range of 10-90x10^{-7}/°C, and the cladding has a CTE in the range of 5-70x10^{-7}/°C.

2. The method in accordance with claim 1, wherein the optically active ion is selected from transition metals and lanthanides.

3. The method in accordance with claim 2, wherein the transition metals with which the glass-ceramic is doped are selected from the group consisting of Ti, V, Cr, Mn, Co, Ni, Cu, or Fe.

4. The method in accordance with claim 3, wherein the transition metals with which the glass-ceramic is doped are selected from the group consisting of Cr, Ni, or Co.

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Marked-up Copy of Claims Showing Changes Made.

5. The method in accordance with claim 2, wherein the lanthanides with which the glass-ceramic is doped are selected from the group consisting of Er, Tm, Nd, Pr, Yb, Dy, or Ho.

6. The method in accordance with claim 1, wherein the nanocrystals are not larger than about 50 nm in size.

~~7. The method in accordance with claim 1, wherein the optoelectronic material is in the form of a clad optical fiber.~~

A1 cont'd

8. The method in accordance with claim 1~~7~~, wherein the optical fiber cladding is a silica glass modified by at least one oxide selected from the group composed of B, Ge, P, Ga, Al, Ta, Ti, or Sb oxides.

9. The method in accordance with claim 8, wherein the optical fiber is a silica glass modified by an oxide selected from the group consisting of B_2O_3, GeO_2, and P_2O_5.

~~10. The method in accordance with claim 7, wherein the glass-ceramic forms a core of the optical fiber, the core has a CTE in the range of 10-90x10^-7^/°C, and the cladding has a CTE in the range of 5-70x10^-7^/°C.~~

11. The method in accordance with claim 1 ~~10~~, wherein the glass-ceramic core has a CTE in the range of 20-70x10^{-7}/°C, and the cladding has a CTE in the range of 15-60x10^{-7}/°C.

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Marked-up Copy of Claims Showing Changes Made.

12. A method of making a nanocrystalline glass ceramic optical fiber having a core that is doped with at least one kind of optically active ion, the method comprising:

a) forming a precursor glass cane;

b) creating a cladding material of modified silica;

c) combining the precursor glass cane into the cladding material;

d) drawing the combined precursor glass cane and cladding material at a temperature above crystallization of the precursor glass, and below the kinetic crystallization temperature of the cladding material;

e) heat treating the draw clad fiber under conditions that promote nanocrystal formation within the core to form a glass ceramic.

A1 cont'd

13. A method of producing a clad optical fiber, the method comprises melting a batch to yield a precursor glass for a nanocrystalline glass-ceramic that is doped with a transition metal, forming a glass cane from the precursor glass melt, mechanically incorporating the glass cane into a cladding tube, drawing a composite glass fiber at a temperature slightly above the liquidus temperature of the drawn composite glass fiber, and subsequently heat treating at least a portion of the clad glass fiber under conditions to develop nanocrystals therein.

14. The method in accordance with claim 1 or 13, which further comprises applying to the glass fiber a cladding glass that is sufficiently viscous at the drawing temperature to permit it to be drawn at a temperature where the core glass, though fluid, and has a sufficiently low vapor pressure to avoid appreciable volatilization.

15. The method in accordance with claim 1 or 13, which further comprises forming the cladding glass by a chemical vapor deposition (CVD) process.

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Marked-up Copy of Claims Showing Changes Made.

16. The method in accordance with claim 1 or 13, which further comprises cladding the glass fiber with a batch adapted to provide a glass consisting essentially of silica and at least one modifying oxide, the glass thus provided having a softening point of at least about 900 °C.

17. The method in accordance with claim 16, which further comprises cladding the fiber with a glass having a composition consisting essentially of silica and at least one oxide selected from the group consisting of B, Ge and P.

A\ cont'd

~~18. An optical fiber comprising: a nanocrystalline glass ceramic fiber core; a cladding surrounding said core, such that migration of component elements between the cladding and the core compositions are minimized by controlling the thermal parameters of the fiberization process.~~

~~19. A optical fiber of claim 18, wherein the migration of component elements are reduced such that the interface between the core and cladding does not adversely affect transmission and waveguiding in the core.~~

~~20. A optical fiber of claim 18, wherein the fiber is drawn at a temperature above crystallization of the core composition, while maintaining the cladding material below its crystallization temperature.~~

~~21. An optical communications system comprising a fiber made according to the method of claim 1.~~